Atlantic States Marine Fisheries Commission

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MEMORANDUM

TO: Atlantic Menhaden Management Board

FROM: Atlantic Menhaden Technical Committee and Stock Assessment Subcommittee

DATE: October 21, 2026

SUBJECT: Stock Projections to Inform 2027-2029 Total Allowable Catch Levels

The Atlantic Menhaden Management Board (Board) will discuss the 2027-2029 total allowable catch (TAC) for Atlantic menhaden at the 2026 Annual Meeting. Per Amendment 3, the TAC is set through Board action, either on an annual basis or for multiple years, based on the best available science. If the Board does not set a TAC for 2027 by December 31, 2026, next year's TAC will automatically be set at the level of the 2026 TAC (186,840 metric tons (mt)).

This memo reviews current stock status, the TAC setting process, the methods for the projections, and the results of the analysis that the Board requested to support the specifications process.

Stock Status

Current stock status is based on the results of the 2025 stock assessment update, which had a terminal year of 2023 (ASMFC 2025). The assessment was not updated for these projections. In 2023, the coastwide Atlantic menhaden stock was not overfished and not experiencing overfishing, with both fecundity and fishing mortality *(F)* between the target and threshold Ecological Reference Points (ERPs) (Figure 1). Although fecundity has declined since a peak in 2012, estimates of biomass and recruitment have shown a slight increase in recent years (Figure 1).

The 2025 assessment update used a revised estimate of natural mortality that was lower than the value used in the 2020 benchmark assessment; this change was peer-reviewed through SEDAR 102 as part of the 2025 ERP Benchmark Assessment[1]. This change resulted in lower estimates of biomass and recruitment and higher estimates of fishing mortality over the entire time-series compared to the 2022 assessment update and contributed to the lower estimates

[1] The Technical Committee (TC) is aware of the new publication by Ault and Luo (2026) that provides a lower estimate of natural mortality. The TC and the SEDAR 102 Review Panel reviewed an unpublished draft of that paper as part of 2025 assessment, which contributed to the revised estimate of natural mortality used in the 2025 update. However, the TC had significant concerns about the methods and assumptions that Ault and Luo used to produce their even lower estimate. The TC has not had the opportunity to review the new publication as a committee to see if those concerns have been addressed.

of the TACs associated with a 40%-60% probability of achieving the ERP *F* target for the 2025 and 2026 projections compared to the 2022 projections (ASMFC 2025).

TAC Setting Process

Since the implementation of coastwide quota management the TAC has varied but overall, has increased from 170,800 mt for 2013–2014 to 233,550 mt for 2023-2025 before being reduced 20% to 186,840 mt for 2026 (Table 1). Table 2 provides each jurisdiction's current (Addendum I) and historic (Amendments 2 and 3) allocations.

At the August 2026 meeting, the Board tasked the Atlantic Menhaden Technical Committee (TC) with developing projections using the ecological reference points (ERPs) and the single-species assessment model (Beaufort Assessment Model, or BAM). Specifically, the Board requested the following projections:

- The TACs that have a 40%-60% probability of exceeding the ERP *F* target, in 5% increments, using 2027-2029 combined and as separate years.
- The probability of exceeding the ERP *F* and fecundity targets and thresholds if the current TAC was changed by -30% to +20% in 5% increments, including 0% (the current TAC of 186,840 mt).

The Board also requested that the TC conduct sensitivity runs around the assumption that the TAC will be fully utilized in 2026 by conducting a subset of runs assuming only 80% of the TAC is used, comparable to the utilization in 2024 and 2025.

As in recent years, the TAC has been informed by the results of projection analysis, which explores a range of TAC alternatives to determine the probability of exceeding the ERP reference points adopted in 2020:

- **ERP target**: the maximum fishing mortality rate (*F*) on Atlantic menhaden that sustains Atlantic striped bass at their biomass target when striped bass are fished at their *F* target and the other ERP species in the model (bluefish, spiny dogfish, weakfish, and Atlantic herring) are fished at their current levels
- **ERP threshold**: the maximum *F* on Atlantic menhaden that keeps Atlantic striped bass at their biomass threshold when striped bass are fished at their *F* target and the other ERP species in the model (bluefish, spiny dogfish, weakfish, and Atlantic herring) are fished at their current levels

Monte Carlo Bootstrap (MCB) runs of the base model run from the single-species model (BAM), are used as the basis for the projection analysis. See the stock assessment update report for details on BAM base run and MCB runs (ASMFC 2025).

Sources of Uncertainty

Predicting the future condition of the stock and the fishery is challenging. Some uncertainty about past and future conditions is included in these projections, resulting in confidence

intervals around the population trajectories under different TACs and a probability of exceeding the ERPs instead of a hard status determination. However, there are additional sources of uncertainty that are not captured in these projections. The true risk of exceeding the ERPs is a combination of the uncertainty that is captured in the probabilities presented in Table 3 - Table 7 and the unknown uncertainty that is not captured here from both the single-species model and the ERP model. The different sources of uncertainty are described below to provide context to the probabilities reported here.

Single-Species Model

The projections have the same methods and assumptions as those run for the benchmark assessment. It is important to note that key uncertainties about natural mortality and fecundity are accounted for in the projections through the use of the MCB process, which resamples from distributions around those parameters. Additionally, during the benchmark assessment (SEDAR 2020), the Stock Assessment Subcommittee (SAS) used a new procedure for projecting recruitment. Instead of assuming a static median value for recruitment, as is done for many assessment projection methodologies, recruitment was projected using nonlinear time-series analysis methods (Deyle et al 2018) which projects future recruitment based on how recruitment has changed in the past under similar conditions. This is done for each MCB run to account for uncertainty. Thus, uncertainty is recognized in the recruitment time series and the methods used for projections adequately accounted for that uncertainty using the best scientific methods available. As with all projection approaches, the uncertainty around recruitment and exploitable biomass will increase with every year the projections are extended beyond the terminal year of the stock assessment.

The projections assumed that the allocation of the TAC in 2027-2029 will be the same as the current allocation. If the Board elects to change the allocation, the results may be affected, since the more northern fisheries tend to harvest larger, older fish than the more southern fisheries. This change could be incorporated into future projections at the Board's request, but no proposed alternatives were provided by the Board for these projections. The projections do not include uncertainty around other aspects of the model structure, such as the selectivity patterns of the bait and reduction fleets, potential future changes in the seasonal or spatial patterns of the fishery, or changes in menhaden growth or weight-at-age. In addition, the TC elected not to apply a retrospective adjustment for the projections based on the results of the Commission's Retrospective Pattern Advice flowchart (ASMFC 2024). Therefore, although the overall scale of the retrospective pattern was within the acceptable bounds for a short-lived species, retrospective patterning contributes to the overall uncertainty that is not fully captured in the projections.

Ecological Reference Point Model

The projections do not incorporate any uncertainty around the ERP target and threshold values, because there is not a comprehensive, quantitative way to estimate that uncertainty in the current model framework. Better quantification of uncertainty around the reference points themselves was a recommendation from the 2025 peer review panel (SEDAR 2025), but some of the uncertainty can be captured through sensitivity runs. Uncertainty in the ERPs includes

both model uncertainty and ecosystem uncertainty. The ecosystem model was sensitive to the relationship between spiny dogfish and striped bass. Changes in the parameters of that relationship or different assumptions about the spatial distribution of the spiny dogfish stock affected striped bass's ability to rebuild to their biomass target under different combinations of striped bass and menhaden *F* rates and therefore resulted in different estimates of the ERP *F* target and threshold.

Uncertainty about future ecosystem conditions also contributes to uncertainty in the ERP target and threshold. For example, in the base run, it was assumed that the low recruitment regime that Atlantic herring were experiencing at the end of the time-series would persist into the future. A sensitivity run was done where it was assumed that Atlantic herring recruitment would return to the long-term average, which resulted in a slightly higher ERP target, indicating Atlantic menhaden could experience a higher *F* rate and striped bass would remain at their biomass target when Atlantic herring were more abundant.

Results

The TACs with a 40%-60% probability of exceeding the *F* target are presented in Table 3. The probabilities of exceeding the *F* target and threshold for a range of TACs representing a 30% decrease to a 20% increase from the current TAC are presented in Table 4, and the probability of falling below the ERP fecundity target and threshold for those TACs is shown in Table 5.

Instead of providing figures for all the scenarios the Board requested, the TC provided figures of the fecundity, recruits, *F*, and landings for scenarios illustrating the bounds of the highest and lowest risk scenarios requested by the Board, in comparison to the status quo scenario. Figure 2 shows projections under the current TAC (186,840 mt). Figure 3 shows projections under a TAC of 110,200 mt (associated with a 40% probability of exceeding the *F* target in 2027). Figure 4 shows projections under a TAC of 224,208 mt (an increase of 20% from the status quo TAC).

The assumption about levels of removals in 2026 had a minimal effect on the results. The estimates of the multi-year TAC that would have a 50% probability of achieving the ERP *F* target for 2027-2029 were approximately 2,000 mt (2%) greater under the lower 2026 removals assumptions (Table 6). The probability of exceeding the ERP *F* target and threshold under the status quo TAC showed no difference (Table 7).

The TC notes that while the Board has the ability to set the TAC for up to three years (i.e., through 2029), the current projections are based on an assessment with a terminal year of 2023, meaning that the majority of the exploitable biomass in 2029 will be comprised of projected rather than observed recruitment. This increases the uncertainty in the projections, particularly for 2029. The TC recommends setting the TAC for 2027-2028 and using the results of the 2028 assessment update to set the TAC for 2029 and subsequent years.

In addition, it is important to note that the values for the ERP target and threshold were based on the definitions currently used in management. The Board can use the ecosystem model developed through the ERP benchmark assessment (SEDAR 2025) to evaluate the trade-offs between predator biomass and menhaden fishing mortality under different ecosystem

assumptions and consider choosing a different ERP target and threshold definition to best meet their management objectives for Atlantic menhaden. If the Board redefined the ERP target and threshold – for example, using different assumptions about the biomass levels of other species in the ecosystem in the future or about striped bass fishing mortality – the values of the reference points and the associated TACs would change.

References

Atlantic States Marine Fisheries Commission (ASMFC). 2025. Atlantic Menhaden Stock Assessment Update. Arlington, VA. 129 pp. Available online: https://asmfc.org/resources/stock-assessment/2025-atlantic-menhaden-stock-assessment-update/

ASMFC. 2024. Retrospective Pattern Advice Document. Arlington, VA. 11p. Available online: https://asmfc.org/wp-content/uploads/2025/01/ASMFC_RetrospectivePatternAdviceDocument_Jan2024.pdf

Deyle, E., A.M. Schueller, H. Ye, G.M Pao, and G. Sugihara. 2018. Ecosystem-based forecasts of recruitment in two menhaden species. Fish and Fisheries 19: 769-781.

Southeast Data, Assessment, and Review (SEDAR). 2020. SEDAR 69 – Atlantic Menhaden Benchmark Stock Assessment Report. SEDAR, North Charleston SC. 691 pp. available online: https://sedarweb.org/assessments/sedar-69/

SEDAR. 2025. SEDAR 102 Stock Assessment Report – ASMFC Atlantic Menhaden and Ecological Reference Points. SEDAR, North Charleston, SC. 424 pp. Available online: https://sedarweb.org/assessments/sedar-102-asmfc-atlantic-menhaden/

Tables

Table 1. History of Atlantic menhaden TAC levels (1 metric ton (mt) is equivalent to 2,204 pounds).

TAC Period	TAC (mt)
2013-2014	170,800
2015-2016	187,880
2017	200,000
2018-2020	216,000
2021-2022	194,400
2023-2025	233,550
2026	186,840

Table 2. Allocation of the coastwide Atlantic menhaden TAC by state, as set by Addendum I to Amendment 3.

State	Addendum I to Amendment 3 (2022) Allocation (%)	Amendment 3 (2017) Allocation (%)	Amendment 2 (2012) Allocation (%)
ME	4.80%	0.52%	0.04%
NH	1.19%	0.50%	0.00%
MA	2.12%	1.27%	0.84%
RI	0.81%	0.52%	0.02%
CT	0.33%	0.52%	0.02%
NY	0.84%	0.69%	0.06%
NJ	11.00%	10.87%	11.19%
PA	0.01%	0.50%	--*
DE	0.27%	0.51%	0.01%
MD	1.17%	1.89%	1.37%
PRFC	1.09%	1.07%	0.62%
VA	75.21%	78.66%	85.32%
NC	0.37%	0.96%	0.49%
SC	0.25%	0.50%	0.00%
GA	0.25%	0.50%	0.00%
FL	0.29%	0.52%	0.02%

* While under Amendment 2, Pennsylvania was not a part of the Board and did not have an allocation

Table 3. The TACs associated with a 40-60% probability of exceeding the ERP fishing mortality rate (*F)* target for 2027-2029 combined and as separate years. For the combined years, the TAC is chosen such that the probability of exceeding the *F* target for 2027-2029 is no greater than the specified percent in any one year. The probabilities are based on the uncertainties specified in the MCB runs.

Probability of exceeding the ERP F Target	TAC for 2027-2029	2027 TAC	2028 TAC	2029 TAC	Percent change from 2026 TAC
40%	110,200	110,200	120,300	120,500	-41%
45%	112,200	112,200	122,900	122,700	-40%
50%	114,200	114,200	124,800	124,800	-39%
55%	116,000	116,000	127,300	127,300	-38%
60%	118,200	118,200	129,800	129,800	-37%

Table 4. Probability of exceeding the ERP fishing mortality rate (*F)* target and ERP *F* threshold for different TAC projections based on the uncertainties specified in the MCB runs.

TAC (Status quo -/+)	Probability of Exceeding the ERP *F* Target			Probability of Exceeding the ERP *F* Threshold		
	2027	2028	2029	2027	2028	2029
130,788 (-30%)	72%	63%	62.5%	0%	0%	0%
140,130 (-25%)	92%	77%	77%	0%	0%	0%
149,472 (-20%)	97%	87.5%	88.0%	0%	0%	0%
158,814 (-15%)	99%	94%	94.5%	0%	0%	0%
168,156 (-10%)	99.5%	98%	98%	0%	0%	0%
177,498 (-5%)	99.5%	99.5%	99.5%	0%	0%	0%
186,840 (0%)	**99.5%**	**99.5%**	**99.5%**	**0%**	**0%**	**0%**
196,182 (+5%)	99.5%	99.5%	99.5%	0%	0%	0%
205,524 (+10%)	99.5%	99.5%	99.5%	0%	0%	0%
214,866 (+15%)	99.5%	99.5%	99.5%	0%	0%	0.5%
224,208 (+20%)	99.5%	99.5%	99.5%	0%	0.5%	1.5%

Table 5. Probability of falling below the ERP fecundity target and ERP fecundity threshold for different TAC projections based on the uncertainties specified in the MCB runs.

TAC (Status quo -/+)	Probability of falling below the ERP Fecundity Target			Probability of falling below the ERP Fecundity Threshold		
	2027	**2028**	**2029**	**2027**	**2028**	**2029**
130,788 (-30%)	41%	31.5%	26.5%	1%	1%	1%
140,130 (-25%)	41%	33%	28%	1%	1%	1%
149,472 (-20%)	41%	34%	29.5%	1%	1%	1%
158,814 (-15%)	41%	35%	31.5%	1%	1.5%	1.5%
168,156 (-10%)	41%	35.5%	33%	1%	1.5%	1.5%
177,498 (-5%)	41%	36.5%	35%	1%	1.5%	2.0%
186,840 (0%)	**41%**	**38%**	**36.5%**	**1%**	**2.0%**	**2.5%**
196,182 (+5%)	41%	39.5%	38.5%	1%	2%	3%
205,524 (+10%)	41%	40.5%	40.5%	1%	2.5%	3.5%
214,866 (+15%)	41%	41.5%	42.5%	1%	2.5%	4%
224,208 (+20%)	41%	42.5%	44.5%	1%	2.5%	4.5%

Table 6. Sensitivity run results showing the TACs in mt associated with a 50% probability of exceeding the ERP fishing mortality rate (*F*) target for 2027-2029 for the base run scenario based on the uncertainties specified in the MCB runs and the scenario assuming 80% TAC utilization in 2026.

Probability of exceeding the ERP F Target	TAC for 2027-2029	2027 TAC	2028 TAC	2029 TAC
50% (Base run)	114,200	114,200	124,800	124,800
50% (80% TAC utilization in 2026)	116,500	116,500	125,600	125,000

Table 7. Sensitivity run results showing the probability of exceeding the ERP fishing mortality rate (*F*) target and ERP *F* threshold for status quo TAC projections for the base run scenario based on the uncertainties specified in the MCB runs and the scenario assuming 80% TAC utilization in 2026.

Scenario	TAC (Status quo -/+)	Probability of Exceeding the ERP F Target			Probability of Exceeding the ERP F Threshold		
		2027	2028	2029	2027	2028	2029
Base run	186,840 (0%)	99.5%	99.5%	99.5%	0.0%	0.0%	0.0%
80% TAC utilization in 2026	186,840 (0%)	99.5%	99.5%	99.5%	0.0%	0.0%	0.0%

Figures

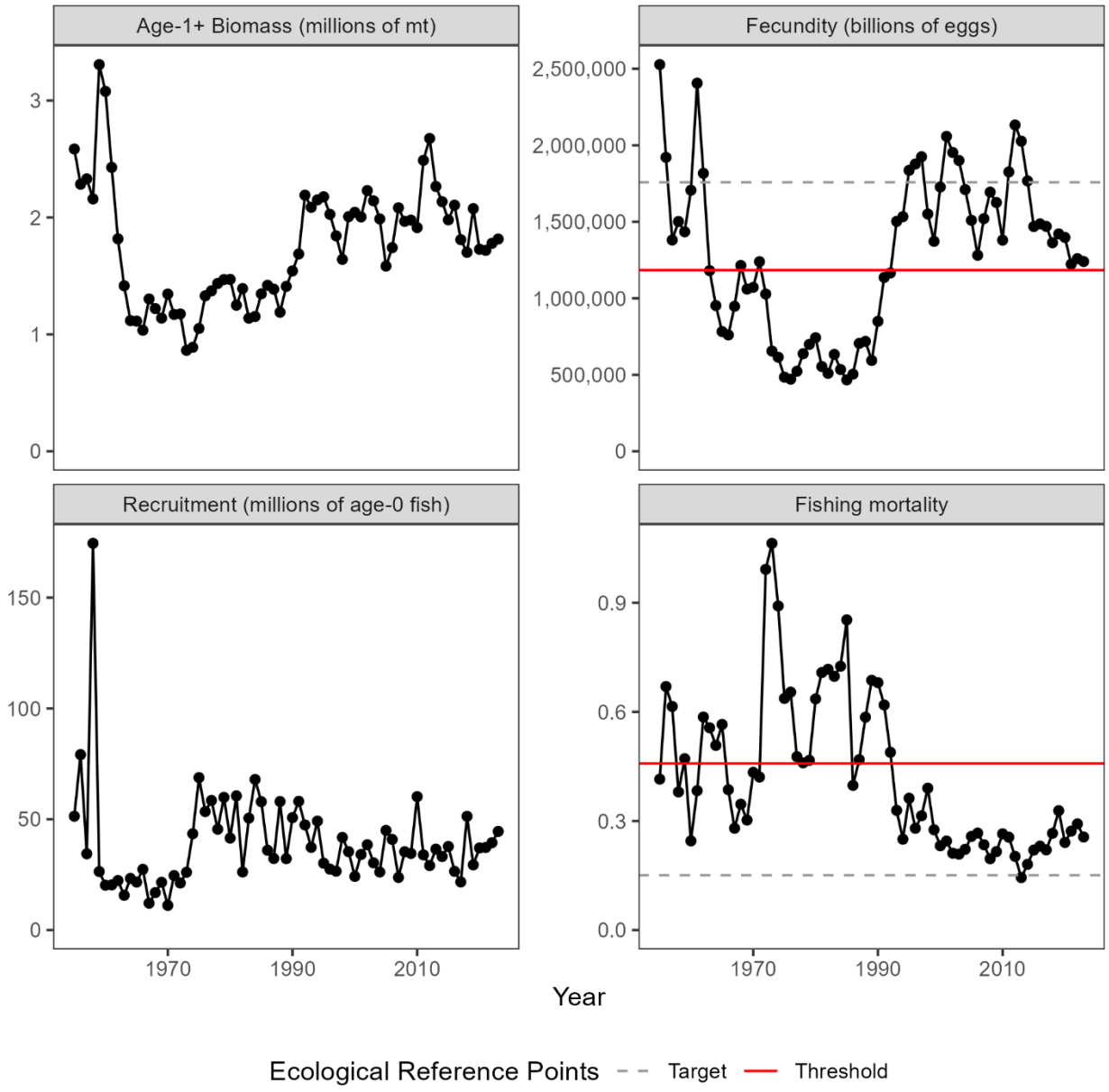


Figure 1. Estimates of biomass, recruitment, fecundity, and fishing mortality from the 2025 stock assessment update for Atlantic menhaden plotted with the ERP targets and thresholds for fishing mortality and fecundity.

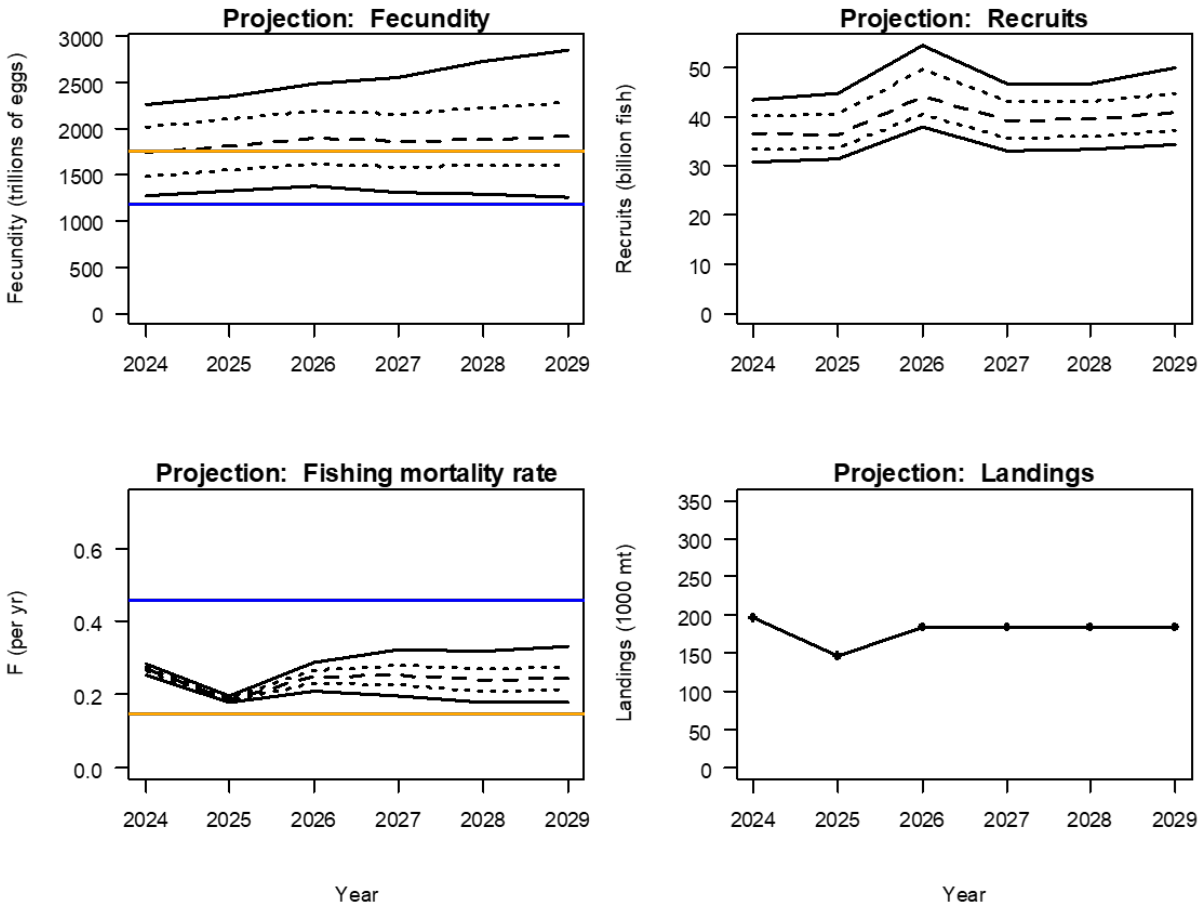


Figure 2. Fecundity, full fishing mortality rate, and recruits projected from 2024 to 2029 for a coastwide total allowable catch of 186,840 mt (status quo). The orange lines represent ERP target fishing mortality rate and fecundity, while the blue lines represent the ERP threshold fishing mortality rate and fecundity. The dashed black line is the 50th percentile (median), the dotted black lines are the 25th and 75th percentiles, and the solid black lines are the 5th and 95th percentiles.

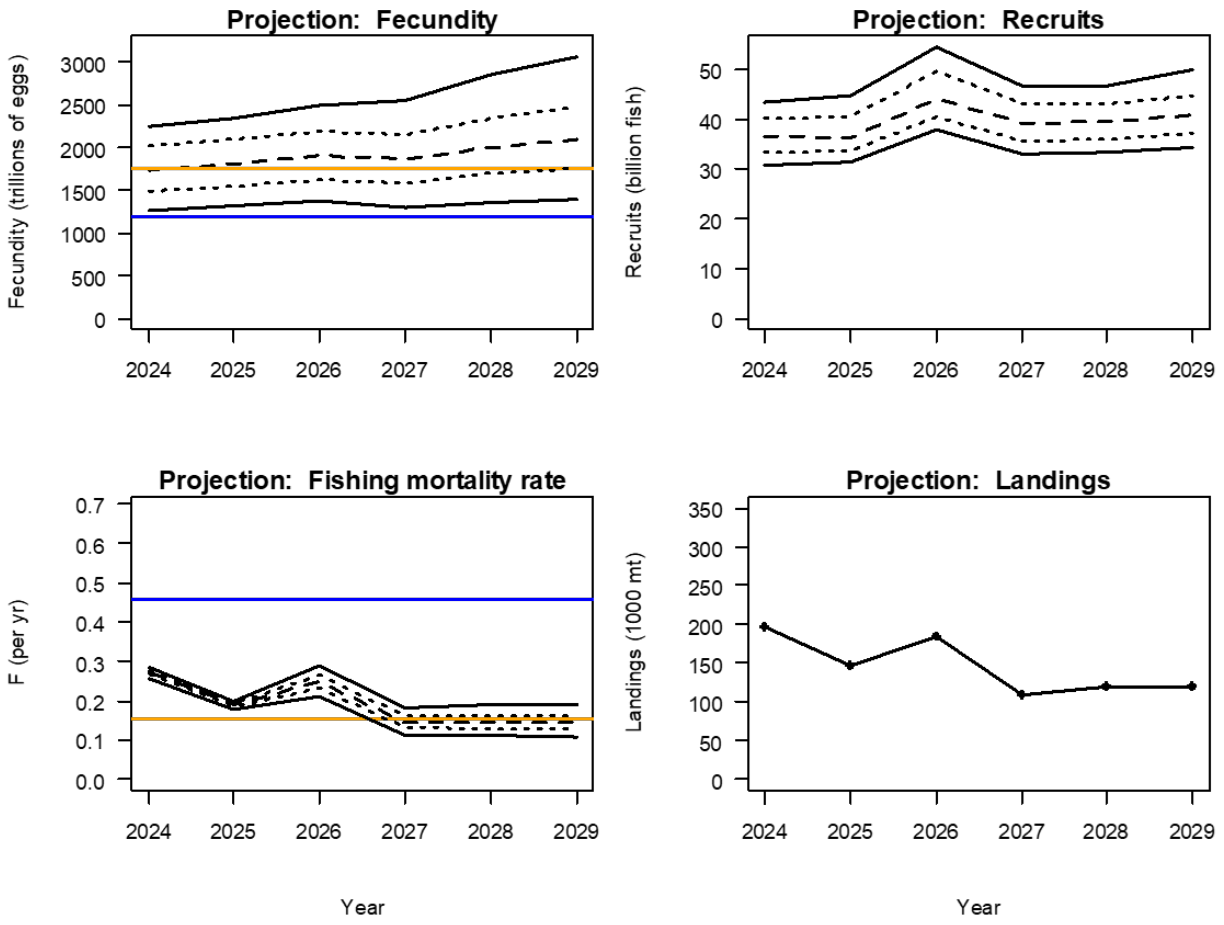


Figure 3. Fecundity, full fishing mortality rate, and recruits projected from 2024 to 2029 for a coastwide total allowable catch with a 40% probability of exceeding the ERP *F* target (110,200 mt). The orange lines represent ERP *F* target and fecundity, while the blue lines represent the ERP *F* threshold and fecundity. The dashed black line is the 50th percentile (median), the dotted black lines are the 25th and 75th percentiles, and the solid black lines are the 5th and 95th percentiles.

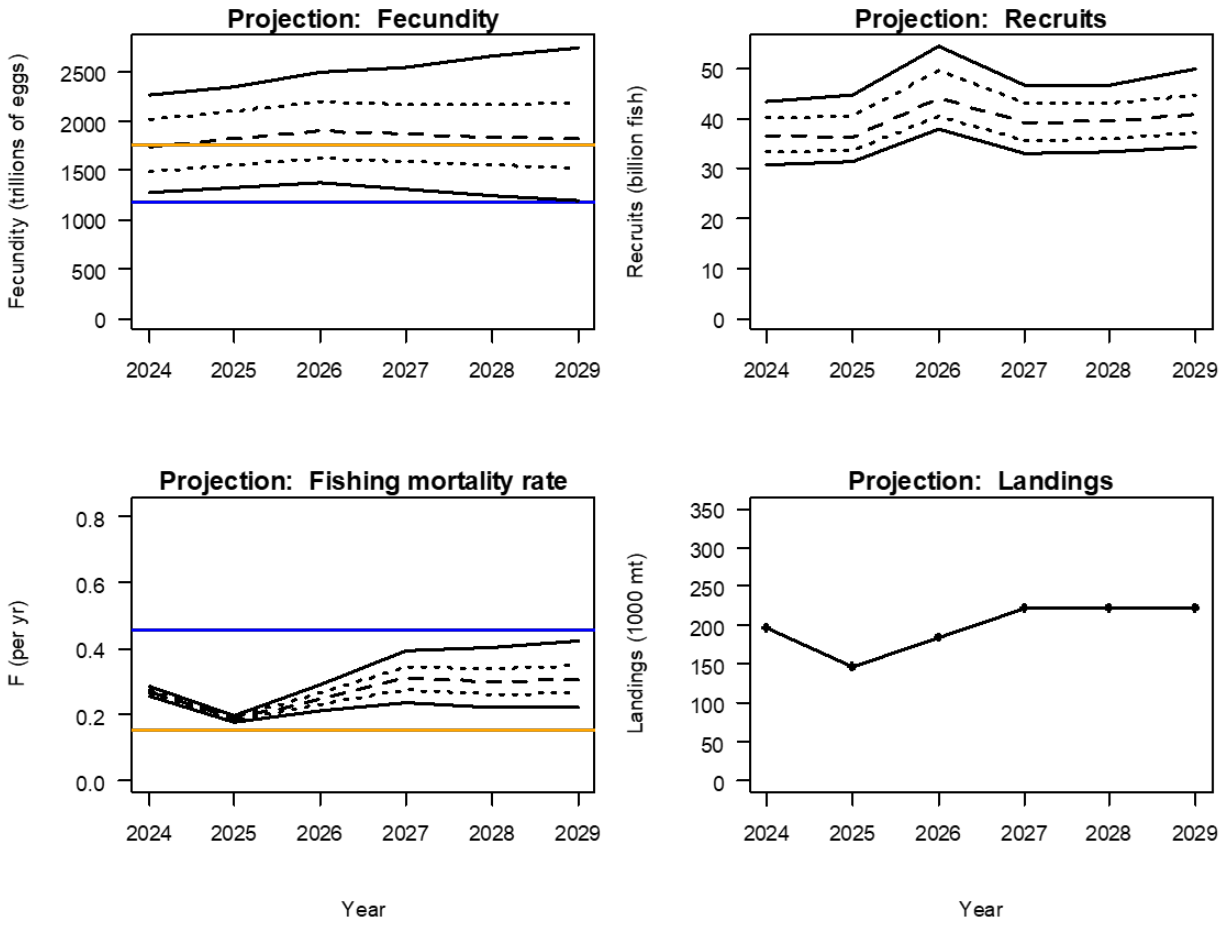


Figure 4. Fecundity, full fishing mortality rate (*F*), and recruits projected from 2024 to 2029 for a 20% increase to the coastwide total allowable catch (224,208 mt). The orange lines represent ERP *F* target and fecundity, while the blue lines represent the ERP *F* threshold and fecundity. The dashed black line is the 50th percentile (median), the dotted black lines are the 25th and 75th percentiles, and the solid black lines are the 5th and 95th percentiles.